

REMARKS

The pending claims in the application are claims 32-36, 38-40, 42, 44, 46-48 and 50-52.

Request for Rejoinder Renewed

Applicants hereby respectfully renew their request for rejoinder of method claims 1-11, 13, 15, 17-19 and 21-31, upon allowance of the product claims 32-36, 38-40, 42, 44, 46-48 and 50-52.¹

Claim Amendments

Claims 22, 32, 39, 51 and 52 have been amended to correct an editorial mistake that occurred with the filing of the response of April 8, 2005 whereby the limitation " $1 < b < (a-1)$ " was inadvertently substituted for the correct limitation " $1 \leq b \leq (a-1)$ " and which carried into the subsequently added claims 51 and 52. That this was merely as a result of editorial error is clear from a comparison of the claims as presented in the responses of December 22, 2004 and April 8, 2005. No new matter (35 USC 132) is entered, as support is clearly found in current claim 1, the claims as originally filed and the specification (see, e.g., paragraphs 0013, 0026, and 0033).

Additionally, withdrawn claim 31 has been amended to correct an obvious grammatical error.

Rejections of Claims and Traversal Thereof

The Rejections Based on Shapiro et. al. in view of Vaartstra et. al.

In the April 5, 2006 Final Office Action, claims 32-36, 38-40, 42, 44 and 46 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shapiro et. al. (US 5,603,988) in view of Vaartstra et. al. (US 5,908,947).

Shapiro et. al. is cited as disclosing metalorganic precursors which satisfy the formula of the claims, allowing, among other limitations, that the metal may be Ti or Ta, that X may be halogen and that all of the groups bonded to the nitrogen atom may be trialkylsilyl. However, Shapiro et. al. is acknowledged as failing to teach or suggest the metals W, Nb and Al. Vaartstra et. al. is cited as disclosing complexes having trialkylsilyl groups "wherein Ti may be substituted by transition metals such as W or may be substituted by Al."

¹ Rejoinder has previously been requested in each of the prior responses and again is respectfully requested in the present response.

The Office alleges that “it would have been obvious to one of ordinary skill in the art at the time of the invention to have used W or Al in the method taught by Shapiro et. al. because Vaartstra discloses that Ti may be substituted by W or Al in complexes with alkylsilyl groups.

Applicants respectfully traverse the rejection and request reconsideration.

The Office in this rejection has seemingly made the argument that because the structural formulae for two different chemical complexes in two unrelated references have the potential for simultaneously containing common elements, Ti and trialkylsilyl groups, it would be obvious to substitute potential alternatives for one of those common elements, as disclosed in one reference, for the like common element of the other reference.

This, however, is not correct.

The position taken by the Office in this respect is that as long as the empirical formulae (excluding the numbers of atoms) of at least one of the complexes of each of two cited references contain some common elements, one can then readily substitute alternative elements disclosed in one reference for the like common element in the other reference, regardless of the actual structure, physical properties, chemical characteristics, etc., which result from such substitution, without any consideration of the whole of the empirical formulae, without any consideration of the actual structures of the complexes, and without even considering whether the complexes in the respective references are homologs, analogs, or (as here) totally non-analogous structures.

This position, however, is at odds with the legal criteria for determining whether *prima facie* obviousness exists.

The requirements for a *prima facie* case of obviousness are set out in MPEP §2143 (“Basic Requirements of a Prima Facie Case of Obviousness”):

“To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined)

must teach or suggest all the claim limitations.” (emphasis added)

The requirement of suggestion or motivation requires a number of factors to be considered when considering the appropriateness of combining the teachings of multiple references each disclosing a different genus of compounds – e.g., (i) the similarities or dissimilarities of the empirical formulae of the compounds in the respective references, (ii) the similarities or dissimilarities of the physical structures of the compounds in the respective references, and (iii) whether the compounds in the respective references are homologues, analogues or non-analogous structures in relation to one another.

In such respect, Applicants direct the Examiner's attention to the structures of the applicants' claimed complexes, as well as the structures of the two cited references, in the following discussion:

The compounds/complexes within the scope of applicants' claims have the following structure:



wherein:

M is selected from the group of Ta, Ti, W, Nb, Al and B;

a is a number equal to the valence of M;

$1 \leq b \leq (a-1)$;

R₁ and R₂ can be the same as or different from one another, and are each independently selected from the group of H, C₁-C₄ alkyl, C₃-C₆ cycloalkyl, and, when M is W, Nb Al or B, R⁰₃Si, where each R⁰ can be the same or different and each R⁰ is independently selected from H and C₁-C₄ alkyl; and

X is selected from the group of chlorine, fluorine, bromine and iodine.

The complexes of Shapiro et. al. according to Formula 2 have the following structure:



wherein (for the sake of brevity)

M is Ti or Ta or mixtures thereof;

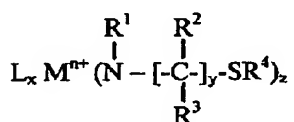
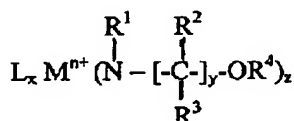
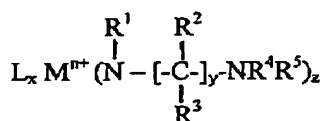
each R is independently alkyl, aryl, allyl, or vinyl; and

X is NR_2 or halogen such as Cl, Br or I;

each x and y is an integer of 0 to 4, provided at least one of x and y is 1; and

each w, z and v is an integer of 1 to 4.

In fundamental contrast to either of the foregoing structures, the compounds of Vaartstra et. al. have one of the following structures:



wherein (for the sake of brevity)

M is Al, Ba, Ga, Hf, In, La, lanthanide, Mg, Mo, Nb, K, Sc, Na, Sr, Ta, Ti, W, V, Y or

Zr, most preferably Ti or Ta;

L is a monoanionic ligand preferably selected from dialkylamino, alkoxy, thiolate, selenolate, alkyl, cyclic alkyl, alkenyl, cyclic alkenyl or trialkylsilyl;

each R^1 , R^2 , R^3 , R^4 , and R^5 is independently H or C_{1-12} alkyl;

x is 0 to 6;

n is the oxidation state of the metal M

y is 1 to 5 and

z is 1 to n.

While the stark dissimilarities of the structural formulae above are, on their face alone, sufficient to show the patentable distinction of the claimed compounds, and a complete lack of analogy between the structures of the cited references, the actual structures contemplated by and within the scope of each, particularly as between the Applicants and Shapiro et. al., on the one hand, and Vaartstra et. al., on the other, are markedly different as well.

Specifically, the complexes of Vaartstra et. al. do not have or specifically allow for the presence of halogen atoms, a critical component of applicants' structures and an optional component in the general teaching of Shapiro et. al. Concerning the monoanionic ligand L, nowhere does Vaartstra et. al. mention halogen or any specific halogen species among the myriad possible moieties and structures recited.

Moreover, even if one were to produce a complex according to Vaartstra et. al. containing a halogen as the monoanionic ligand, one would then have a structure free of the trialkylsilyl ligand, for the only structures of Vaartstra et. al. that allow for a trialkylsilyl group are those in which the trialkylsilyl group is the monoanionic ligand directly bonded to the metal M.

By contrast, applicants and Shapiro et. al. provide that the silyl moiety is a part of the amino substitution on the metal M. In addition to such fundamentally disparate structural character, there are also fundamental distinctions in the nitrogen-containing moieties of Vaartstra et. al., namely the alkylenediamido, thioalkenylamido or hydroxy- or alkoxy- alkyleneamido ligands.

Given the marked chemical and structural differences, combined with the general unpredictability of the chemical art where such disparate chemical and structural character is present, it is clear that Vaartstra et. al. and Shapiro et. al. are not combinable references, and that, even if for the sake of argument such references were to be considered as being combinable, even then there is nothing that would motivate or suggest the possibility or desirability of substituting the non-preferred metal atoms of Vaartstra et. al. for the metal atoms of Shapiro et. al.

The mere fact that both structures may have alkylsilyl moieties is not sufficient. More critically, the fact that the alkylsilyl moieties are in entirely different and non-analogous configurations within the structures of each reference, further underscores the lack of any derivative basis in the references for the applicants' claimed invention, and reemphasizes the lack of any motivation for the combination proposed by the Office. Furthermore, it is well established that the mere fact that

the prior art could in some deconstructive/reconstructive way be combined to make the modified structures theorized in the Office Action does not make the modified structures obvious unless the prior art suggests the desirability of the modification. (See *In re Mills*, 16 USPQ2d 1430 (Fed. Cir. 1990))

In view of the foregoing, applicants respectfully request that the rejection of claims 32-36, 38-40, 42, 44 and 46 over Shapiro et. al. in view of Vaartstra et. al. be withdrawn and the claims passed to allowance.

The rejection over Shapiro et. al. in view of Kirlin et. al. and Su et. al.

In the April 5, 2006 Final Office Action, claim 42 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Shapiro et. al., as applied above, in view of Kirlin et. al. and further in view of Su et. al. Kirlin et. al. is said to disclose that titanium aluminum nitride is a desirable barrier layer that can be prepared with metalorganic precursors and Su et. al. has been cited as disclosing the formation of an aluminum nitride barrier using alkylalanes.

The Office alleges that it would have been obvious to one of ordinary skill in the art at the time of the invention to have combined the disclosures of each of the references because a mixed barrier layer is useful and the precursors taught by Shapiro et. al. and Su et. al. are useful in allowing low temperature deposition of a barrier layer.

Applicants respectfully traverse this ground of rejection.

Contrary to the assertion of the Office, Shapiro et. al. contains no derivative basis for the metalorganic precursors claimed by applicants and fails to disclose any aluminum source reagent. Thus, even if the secondary references were applied in the manner proposed in the Office Action, the combined disclosures of Shapiro et al., Kirlin et al. and Su would still not suggest or motivate the use of the specific metalorganic precursors claimed, and the hypothetical proposed combination of references would fail to yield any *prima facie* basis for applicant's claimed invention.

Even if such lack of any tenable basis for the rejection were ignored, the rejection would still fail to present a *prima facie* case for obviousness, since Su et. al. teach a method for the formation of

purified aluminum nitride, and not (as contended in the Office Action) the formation of an aluminum nitride barrier layer. Indeed, nothing in Su et. al. suggests that the process therein disclosed could be used for forming an aluminum nitride barrier layer. Su et. al. employ alkylalane compounds in combination with anhydrous ammonia in a precipitation reaction in a suitable solvent following which the precipitate is collected and subjected to pyrolysis to generate high purity aluminum nitride materials.

There is therefore no basis in Su et. al. that would suggest, or from which one would infer, that one could employ such materials in a non-solvent medium, for a non-precipitation reaction, and without precipitate pyrolysis, as would be required if such materials, or even just the alkylalanes thereof, were to be used as proposed by the Office for vapor deposition of an aluminum nitride or aluminum nitride-containing barrier layer. It therefore is apparent that such extraction of alkylalanes from Su et al. requires arbitrary and wholesale disregard of the express solvent-phase precipitation and precipitate pyrolysis teachings of Su et al., without any basis or rationale in the reference itself for such extraction.

Thus, as previously noted, Shapiro et. al. contains no teaching or suggestion of any aluminum component. Kirlin et. al. discloses a number of barrier layers including titanium aluminum nitride, N-deficient aluminum nitride, and doped aluminum nitride, and discloses that such barriers may be deposited from metalorganic precursors, but Kirlin et al. does not teach, suggest or motivate the use of the particular alane reagents required by applicants' claim 42. Further, Kirlin et al. contains no disclosure, nor does Shapiro et. al., of the use of an aluminum reagent in combination with the metalorganic precursor recited in claim 39, from which claim 42 depends.

Based on all of the foregoing, it is apparent that Shapiro et al., Su et al., and Kirlin et al. cannot in any way be aggregated to yield the subject matter of applicants' claim 42. It therefore is respectfully requested that the rejection of such claim be withdrawn.

The rejection based on Shapiro et. al. in view of Vaartstra et. al.

Claim 50 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Shapiro et. al. in view of Vaartstra et. al. (US 6,445,023). Shapiro et. al. is cited as above, but is acknowledged as failing to disclose boron. Vaartstra et. al. is said to disclose a boron source for a mixed nitride in a metalorganic deposition in which the boron source is diborane.

The Office Action alleges that it would have been obvious to have used the combination of the source taught by Shapiro et. al. because Vaartstra et. al. teach that this produces a useful barrier and because diborane is a source of boron which is conventional in the art.

Claim 50 depends from claim 39, as to which it has already pointed out that Shapiro et. al. contains no derivative basis for the metalorganic precursors claimed by applicants. The proposed hypothetical combination of references therefore fails to present a *prima facie* case on such ground alone.

Thus, there is nothing in Vaartstra et al. that can be combined with Shapiro et al. to yield the metalorganic precursor composition of claim 50, and nothing in Vaartstra et al. suggesting that “borane, decaborane, alkylboranes and amidoboranes” could be combined with specific metalorganic precursors of the present invention to make an effective barrier layer.

In light of the foregoing, it is respectfully requested that the rejection of claim 50 be withdrawn.

The rejection based on Shapiro et. al. in view of Bhandari et. al. and Muroyama et. al.

Claims 47 and 48 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Shapiro et. al. in view of Bhandari et. al. and Muroyama et. al.

Applicants respectfully traverse the rejection.

Claims 47 and 48 are of dependent form under claim 39. Shapiro et al. has already been shown to lack any basis for the recited metalorganic precursor compounds of claim 39. Accordingly, the extraction of specific features of Bhandari et al. and Muroyama et al. does not alter the fact that the resulting combination is devoid of the presence of the specific metalorganic precursor compounds of applicants' claimed invention.

The Office has conceded that “Shapiro et. al. is silent as to an additional silicon source” (page 4, line 14 of the April 5, 2006 Final Office Action). Given such silence, and the absence of any apparent infirmity in the disclosed compounds or structure of Shapiro et al., why would one of ordinary skill import additional layer structure from Bhandari et al.? The Office Action merely

states that "Bhandari et al. discloses that a TiSiN or TaSiN barrier is useful" (page 4, line 15 of the April 5, 2005 Final Office Action).

Independent utility is not the test of obviousness. It is fundamental §103 law that before prior art references can be combined or modified, there must be some suggestion or motivation found in the art to make the combination or modification. In re Dance, 160 F.3d 1339, 1343 (Fed. Cir. 1998); Heidelberger Druckmaschinen v. Hantscho Commercial, 21 F.3d 1068, 1072 (Fed. Cir. 1994); In re Geiger, 815 F.2d 686, 688 (Fed. Cir. 1987); Lindemann Maschinenfabrik v. Am Hoist and Derrick, 730 F.2d 1452, 1462 (Fed. Cir. 1984). "It is insufficient to establish obviousness that the separate elements of the invention existed in the prior art, absent some teaching or suggestion, in the prior art, to combine the elements." Arkie Lures, Inc. v. Gene Larew Tackle, Inc., 119 F.3d 953, 957 (Fed. Cir. 1997).

Here, there is no motivational basis in Bhandari et al. for the proposed combination, and there is no motivational basis in Shapiro et al. for the proposed combination. The Office has set out no rationale for why one of ordinary skill would make any modification of Shapiro et al. in light of the existence of Bhandari et al. This is a fatal deficiency in the citation of Bhandari et al. - as the Federal Circuit has clearly stated, it is incumbent on the Examiner to establish a factual basis to support the legal conclusion of obviousness. In re Fine, 837 F.2d 1071 (Fed. Cir. 1988).

The citation of Muroyama et al. is likewise unavailing to provide any tenable basis of support for a §103 rejection of claims 47 and 48. Again, no rationale has been set forth in the Office Action as to why one of ordinary skill would in any way seek to combine the disclosure of such reference with the disclosure of Shapiro et al. It is merely stated at page 4 of the Office Action that Muroyama et al. "disclose a precursor with formula (I) in which M is Si and in which R1 and R2 are the same methyl or other alkyl and X is F ... and b is 2...[wherein] ethyl is an alkyl group" (page 4, lines 17-20 of the April 5, 2006 Final Office Action). This observation fails to state any basis of obviousness of applicants' claimed invention.

The law is clear in this respect. "It is insufficient to establish obviousness that the separate elements of the invention existed in the prior art, absent some teaching or suggestion, in the prior art, to combine the elements." Arkie Lures, Inc. v. Gene Larew Tackle, Inc., 119 F.3d 953, 957 (Fed. Cir. 1997). "[T]he fact that references *could* conceivably be modified or combined is

insufficient to meet this criterion. In re Rouffet, 149 F.3d 1350, 1357 (Fed. Cir. 1998); In re Mills, 916 F.2d 680, 682 (Fed. Cir. 1990)).

It therefore is evident that no *prima facie* basis has been presented for the rejection of claims 47 and 48. For such reason, it is respectfully requested that such rejection be withdrawn.

Withdrawal of Finality of the Rejection/Entry of Amendments

In the event the Office maintains any basis of rejection of applicants' claims, applicants respectfully request that the finality of the rejection of April 5, 2006 be withdrawn and that the claim amendments presented herein be entered for purposes of appeal.

Entry of the amendments is proper since the amendments clearly correct a prior editorial mistake and, relative to the current bases of rejection, are neutral in effect, i.e., no change in the issues or scope of matters for appeal is involved.

Withdrawal of the finality of the rejection is appropriate as being premature. Specifically, the rejections of claims 42, 47, 48 and 50 are mere reiterations of the grounds of rejection set forth in the October 17, 2005 Office Action for which applicants had presented cogent arguments in rebuttal in their response of January 17, 2006; yet, no acknowledgement or arguments as to the persuasiveness of those rebuttals has been made in the Final Office Action. These rejections were first presented in the Office Action of October 17, 2005: prior thereto claims 42, 47 and 48 had been provisionally allowed in the Office Action dated May, 2, 2005. Inasmuch as the Examiner has not responded to Applicants initial rebuttal arguments, applicants have no knowledge of the examiner's position relative to those rebuttal arguments. Thus, relative to these claims, it cannot be said that clear issues have been developed. More importantly, the examiner has failed to acknowledge the entry of new Claims 51 and 52, which were presented in applicants' response of October 17, 2005. Clearly, it cannot be said that "a clear issue has been developed between the Examiner and the Applicant" with respect to these claims or that applicants have received a "full and fair hearing" thereon.

In light of the foregoing, withdrawal of the finality of the rejection is warranted and appropriate. (MPEP 706.07)

Fees Payable

No fees are payable at this time as this response is being filed prior to the end of the shortened statutory period and no changes have been made with respect to the number of independent or total claims.

CONCLUSION

Applicants have satisfied all requirements for patentability. The pending claims are free of the art and fully comply with the requirements of 35 U.S.C. §102 and §103. It therefore is requested that Examiner Everhart reconsider the patentability of the pending claims in light of the distinguishing remarks herein, and withdraw the rejections made in the April 5, 2006 Office Action, thereby placing the application in condition for allowance. A Notice of Allowance is merited and respectfully requested. In the event that any issues remain, Examiner Everhart is requested to contact the undersigned attorney at (919) 419-9350 to resolve same, so that this application can be passed to issue at an early date.

Respectfully submitted,



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